No English title available.

Patent Number:	GB1255952
Publication date:	1971-12-08
Inventor(s):	
Applicant(s):	
Requested Patent:	☑ GB1255952
Application	GBD1255952 19680112
Priority Number(s):	GB19680001770 19680112
IPC Classification:	
EC Classification:	B60C1/00H, B60C11/00, B60C11/18
Equivalents:	☐ DE1901448, ☐ FR2000207, ☐

Abstract

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Description

(54) IMPROVEMENTS IN OR RELATING TO PNEUMATIC TYRES

(71) We, DUNLOP HOLDINGS LIMITED, formerly THE DUNLOP COMPANY LIMITED, a British Company, of Dunlop House, Ryder Street, St. James's, London S.W. 1., do hereby declare the invention, for which wc pray that a patent may be granted to us, and the method by which it is to be per formed, to be particularly described in and by the following statement:-

This invention relates to pneumatic tyres.

It has been found that the grip of pneumatic tyres on a wet road reduces, with increasing rapidity, when the tread has been worn beyond about half the depth of the tread pattern, the grip of tyres which are about 60% worn approaching that, under certain wet conditions, of a substantially bald tyre tread.

It is known that increased grip can be obtained by using a suitable synthetic tread rubber compared with, for example, natural rubber, but synthetic rubbers frequently run at higher temperatures on account of the faot that they have a higher hysteresis loss than that of natural rubber.

It is an object of the present invention to obtain a pneumatic tyre with improved road grip in wet conditions when the tread is substantially worn.

According to the present invention a pneumatic tyre tread is provided in a position substantially radially inwardly of the groundcontacting surface of the tread in the unworn state with a region incorporating a layer of a tread rubber composition having a higher braking coefficient than that of the rubber composition radially outwardly of the said region to provide an increased wet grip propetty to the tyre in a worn state of the tread.

In one form of the invention, particularly useful for giant tyres provided with at least one groove, a layer of rubber composition of higher braking coefficient extends in a region, e.g. 30% but not greater than 50% of the depth of tread grooves measured from the base of the groove radially outwardly and may extend radially inwardly of the groove bases. The said layer of composition may either extend symmetrically with respect to the mid-circumferential plane of the tyre across substantially the whole tread width and be of equal thickness or it may be thicker at or adjacent to each tread shoulder or be disposed solely in each shoulder region.

Alternatively the said layer of composition may be asymmetrically disposed with respect to the mid-circumferential plane, e.g.

only one tread shoulder being provided with the said composition.

The term "braking coefficient" as used herein and throughout this specification will be understood to mean the coefficient of friction which is obtained between rubber extending across the whole of the tread surface of a tyre, when mounted upon a vehicle wheel, and a water-wet surface with which the tyre is in contact when the wheel is braked. either in a locked or slipping condition relative to said surface, the braked slippage being slippage to give maximum retardation as measured, for example, by a decelerometer installed in the vehicle, the wheel travelling in a straight line and the vehicle speed lying within the range of 15 m.p.h. to 50 m.p.h.Further the term "higher braking coefficient" will be understood to relate to a comparison between the braking coefficient which is obtained, in a first test, under the above-defined conditions, between that type of rubber which forms part of the tread region, when the whole of the tread surface is formed of such rubber, and said waterwet surface, and that braking coefficient which is obtained, in a second test, under the same above-defined conditions, between that type of rubber which forms another part of the tread region, when the whole of the tread surface is formed of such rubber and the same water-wet surface, the speeds of movement of the two rubbers relatively to said surface being substantially equal, the vehicle speeds and tyre loads being substantially equal and the temperatures at rubbing surfaces of the two rubbers being substantially equal in two tests.

One embodiment of the invention will now be described in more detail with reference to the accompanying

drawings wherein:
Figure 1 shows a diagrammatic fragmentary axial cross-sectional view of a pneumatic tyre according to the embodiment of the invention,
Figure 2 shows a diagrammatic fragmentary axial cross-sectional view of a pneumatic tyre according to a first modification of the embodiment of the invention,
Figure 3 shows a diagrammatic fragmentary axial cross-sectional view of a pneumatic tyre according to a second modification of the embodiment of the invention,
Figure 4 shows a diagrammatic fragmentary axial cross-sectional view of a pneumatic tyre according to a third modification of the embodiment of the invention,
Figure 5 shows a diagrammatic fragmentary axial cross-sectional view of a pneumatic tyre according to a fourth modification of the embodiment of the invention.

According to the embodiment of the invention shown in Figure 1 a pneumatic tyre for use on a track is manufactured having a size of 9.00-20 and a tread pattern groove depth of 14 mm. measured radially inwardly from the ground contacting surface of the unworn tyre.

The tread 1 comprises three radially adjacent regions 3, 4 and 5 of respectively different composition and is applied to a carcass 6 made from plies which are embedded in a natural rubber composition.

The first of the three compositions is formed into a radially outermost "top cap " 3 and has a higher abrasion resistance than the remainder of the rubber in the tread.

The top cap 3 extends from the ground contacting surface 7 of the unworn tyre radially inwardly for a distance of 10 mm i.e. within 4 mm. of the base of the circumferentially extending grooves 2 moulded into the tread 1. The composition of the top cap is as follows:
Example I
Top Cap

Parts by
Weight
Natural Rubber 100.0
Sulphur 2.5
Canto cure MOR (Registered
Trade Mark) - Obtainable
from Monsanto 0.6
Stearic Acid 2.0
Antioxidant Nonox ZA
obtainable from ICI Limited 1.5

Process Oil 5.0
Zinc Oxide 5.0
ISAF Black 50.0
166.6

A second rubber composition is used to form an intermediate layer 4 and has a higher braking coefficient than that of the top cap composition. The layer 4 is disposed between the radially outermost wearing top cap 3 and a sub-tread 5 which is disposed in the radially innermost region of the tread 1. The intermediate layer 4 extends symmetrically with respect to the midcircumferential plane across substantially the whole tread 1 and is formed such that the radially outer surface thereof has undulations, being disposed radially inwardly of the base of the grooves 2 yet extending radially outwardly thereof in the regions between the grooves 2. The radially inner surface of the intermediate layer 4 is substantially smooth, all points lying on said surface being substantially equidistant from the ground contacting unworn surface of the tyre tread.The composition of the intermediate layer 4 is as follows:
Example II
Intermediate - High Grip

Parts by
Weight
High Styrene SBR (Intol M401)
-obtainable from ISR in U K) 50.0
SBR 1500 50.0
Sulphur 1.8
Santocure MOR (Registered
Trade Mark) obtainable
from Monsanto 1.0
Stearic Acid 1.5
Antioxidant Nonox ZA -
obtainable from ICI Limited 1.5
Process Oil 5.0
Zinc Oxide 3.0
ISAF Black 55.0
168.8

The sub-tread 5 is of a low hysteresis natural rubber composition having a lower hysteresis value than the remainder of the tread and allows a lower temperature build up during running conditions than the temperature build up which would result were it to have a higher hysteresis value such as that of the composition used for the intermediate layers 4.

The composition of said subztread 5 is as follows:-
Example 111 Sub-Tread

Parts by.

Weight
Natural Rubber 100.0
Sulphur 2.5

Santocure MOR (Registered
Trade Mark) - obtainable
from Monsanto 0.6
Stearic Acid 2.0
Antioxidant Nonox ZA
obtainable from ICI Limited 1.5
Process Oil 6.0
Zinc Oxide 5.0
F.E.F. Black 45.0
162.6

In one form of the tyre according to the embodiment of fhe invention the composition of the top cap 3 described above is substituted by the following composition:
Example IV
Top Cap

Parts by
Weight

Natural Rubber 50.0
SBR 1500 50.0
Sulphur 2.2
Santocure (Registered Trade Mark)obtainable from Mon santo 0.8
Stearic Acid 1.5
Antioxidant Nonox ~ZA - obtainable from ICI Limited 1.5
Process Oil 5.0
Zinc Oxide 3.0
ISAF Black 50.0
164.0

In a first modification of the embodiment shown in Figure 2 a tyre of the type described in the embodiment is constructed but in this instance the intermedate layer 4 does not extend symmetrically across substantially the whole of the tread 1, but is in two parts accommodated respectively in two axially spaced-apart regions 4a and 4b adjacent the tyre tread shoulders 9, said two regions 4a and 4h being disposed symmetrically with respect to the mid-circumferential plane "X-X" of the tyre, thus leaving the crown portion 8 of the tread 1 devoid of said higher braking coefficient composition.

The crown portion 8 of the tyre tread 1 consequently comprises only two compositions viz. that of the top cap 3 which extends radially inwardly of the groundcontacting surface of the unworn tyre and a sub-tread 5 disposed radially inwardly of said top cap 3.

According to a second modification of the embodiment of the invention shown in Figure 3, a tyre of the type described in the embodiment is constructed but in this instance, the intermediate layer 4 does not extend symmetrically across substantially the whole of the tread 1 but extends symmetrically across only the crown portion 8 of the tread, leaving the tread shoulder regions 9 devoid of said second rubber composition.

According to a third modification of the embodiment of the invention shown in Figure 4 a tyre of the type described in the first modification of the embodiment of the invention is constructed but in this instance in addition to the absence from the crown region 8 of the tread 1 of the said intermediate layer 4 it is also deprived of said subtread 5. Thus the crown region 8- of the tyre tread 1 in this instance comprises only rubber of said top cap composition.

The tread shoulder regions 9 comprise however all three compositions used for the top cap 3, intermediate layer 4 and subtread 5.

According to a fourth modification. shown in Figure 5, of the embodiment of the invention a tyre of the type described in the embodiment of the invention is constructed.

However, in this case said subtread 5 is not provided in the crown region 8 of the tyre tread, said intermediate layer 4 extending from the said top cap 3 radially inwardly to the carcass 6 of the tyre in the crown portion 8 of the tread 1.

During wear of the tyre tread the rubber of higher braking coefficient forming the intermediate layer 4 will be exposed when there is only about 4 mm. depth of groove remainng so that, at this stage, when the difficulty of eliminating water by means of the grooves has greatly increased, compared with the drainage available when the tread is new, the rubber of higher braking coefficient will grip the road to provide supplementary grip during braking and acceleration up to the stage when the tyre tread is worn so as no longer to be suitable for use.

Since the rubber of higher braking coefficient forms only a small part of the total tread construction, the heat build-up as a result of its high hysteresis property is striotly limited, and the tread as a whole does not exhibit markedly increased temperature build-up during running compared with allnatural rubber treads operating under the same conditions.

WHAT WE CLAIM IS:

1. A pneumatic tyre comprising a tread provided, in a position substantially radially inwardly of the ground-contacting surface of the tread in the unworn state, with a region incorporating a layer of a tread rubber composition having a higher braking coefficient than that of the rubber composition radially outwardly of the said region to provide an increased wet grip property to the tyre in a worn state of the tread.

2. A pneumatic tyre according to claim 1 wherein said tyre is provided with at least one groove and a layer of said rubber composition of higher braking coefficient extends in a region or regions from not greater

WARNING end of DESC field may overlap start of CLMS **.

Claims

WARNING start of CLMS field may overlap end of DESC **.

Santocure MOR (Registered
Trade Mark) - obtainable
from Monsanto 0.6
Stearic Acid 2.0
Antioxidant Nonox ZA
obtainable from ICI Limited 1.5
Process Oil 6.0
Zinc Oxide 5.0
F.E.F. Black 45.0
162.6

In one form of the tyre according to the embodiment of fhe invention the composition of the top cap 3 described above is substituted by the following composition:
Example IV
Top Cap

Parts by
Weight
Natural Rubber 50.0
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Sulphur 2.2
Santocure (Registered Trade
Mark)obtainable from Mon
santo 0.8
Stearic Acid 1.5
Antioxidant Nonox ~ZA -
obtainable from ICI Limited 1.5
Process Oil 5.0
Zinc Oxide 3.0
ISAF Black 50.0
164.0

In a first modification of the embodiment shown in Figure 2 a tyre of the type described in the embodiment is constructed but in this instance the intermedate layer 4 does not extend symmetrically across substantially the whole of the tread 1, but is in two parts accommodated respectively in two axially spaced-apart regions 4a and 4b adjacent the tyre tread shoulders 9, said two regions 4a and 4h being disposed symmetrically with respect to the mid-circumferential plane "X-X" of the tyre, thus leaving the crown portion 8 of the tread 1 devoid of said higher braking coefficient composition.

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Figure 3, a tyre of the type described in the embodiment is constructed but in this instance, the intermediate layer 4 does not extend symmetrically across substantially the whole of the tread 1 but extends symmetrically across only the crown portion 8 of the tread, leaving the tread shoulder regions 9

devoid of said second rubber composition.

According to a third modification of the embodiment of the invention shown in Figure 4 a tyre of the type described in the first modification of the embodiment of the invention is constructed but in this instance in addition to the absence from the crown region 8 of the tread 1 of the said intermediate layer 4 it is also deprived of said subtread 5. Thus the crown region 8- of the tyre tread 1 in this instance comprises only rubber of said top cap composition.

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During wear of the tyre tread the rubber of higher braking coefficient forming the intermediate layer 4 will be exposed when there is only about 4 mm. depth of groove remainng so that, at this stage,.when the difficulty of eliminating water by means of the grooves has greatly increased, compared with the drainage available when the tread is new, the rubber of higher braking coefficient will grip the road to provide supplementary grip during braking and acceleration up to the stage when the tyre tread is worn so as no longer to be suitable for use.

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WHAT WE CLAIM IS:

1. A pneumatic tyre comprising a tread provided, in a position substantially radially inwardly of the ground-contacting surface of the tread in the unworn state, with a region incorporating a layer of a tread rubber composition having a higher braking coefficient than that of the rubber composition radially outwardly of the said region to provide an increased wet grip property to the tyre in a worn state of the tread.

2. A pneumatic tyre according to claim 1 wherein said tyre is provided with at least one groove and a layer of said rubber composition of higher braking coefficient extends in a region or regions from not greater

than 50 per cent of the depth of the tread grooves measured from the bases of the grooves radially outwardly.

3. A pneumatic tyre according to either of the preceding claims wherein said layer of rubber composition of higher braking coefficient extends radially inwardly of the groove bases.

4. A pneumatic tyre according to any of the preceding claims wherein said layer of rubber composition of higher braking coefficient extends symmetrically with respect to the mid-circumferential plane of the tyre across substantially the whole tread width.

5. A pneumatic tyre according to any of claims 1 to 3 wherein said layer of rubber composition of higher braking coefficient is in two parts disposed solely one in each tread shoulder region so that the crown region of the tread is devoid of said composltion.

6. A pneumatic tyre according to claim 5 wherein said layer parts of rubber composition of higher braking coefficient are disposed symmetrically with respect to the mid-circumferential plane of the tyre.

7. A pneumatic tyre according to any of claims 1 to 3 wherein said layer of rubber composition of higher braking coefficient is disposed in only one tread shoulder region.

8. A pneumatic tyre according to any of the preceding claims wherein the radially outermost part of the

tread is of a composition having a higher abrasion resistance than the remainder of the rubber of the tread.

9. A pneumatic tyre according to claim 8 wherein the radially innermost part of the tread is of a composition having a lower hysteresis value than the remainder of the rubber of the tread.

10. A pneumatic tyre constructed and arranged substantially as described herein with reference to any of the accompanying drawings.

1,255,952 COMPLETE SPECIFICATION
1 SHEET

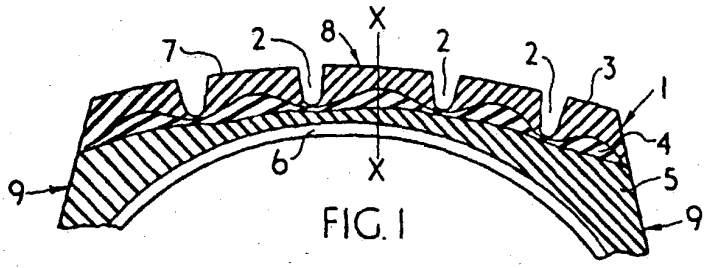

FIG. 1

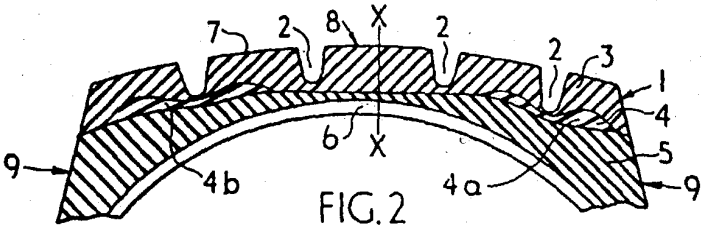

FIG. 2

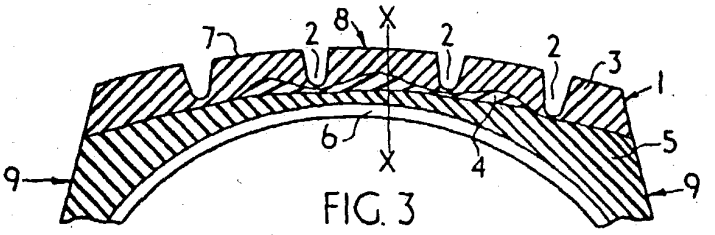

FIG. 3

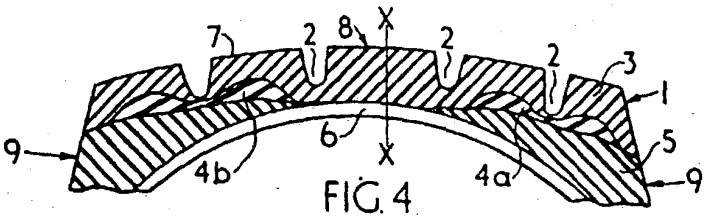

FIG. 4

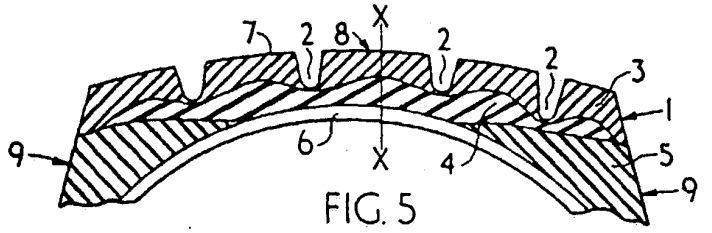

FIG. 5